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## Phase transformations and dual thermo-elastic and super-elastic characterization of shape memory alloys

Shape memory alloys are new class of functional materials, due to the stimulus response to the external effects like stressing and variation of temperature. These alloys exhibit a peculiar property called shape memory effect initiated by cooling and stressing in low temperature condition. These alloys exhibit dual thermo-elasticity and super-elasticity. Shape memory effect is performed thermally on heating and cooling after first cooling and stressing treatments, therefore this behavior is called Thermo-Elasticity (TE). Super-elasticity is performed in only mechanical manner by stressing and releasing material in the parent austenite phase region. Shape memory effect is based on martensitic transformation, which is a solid state phase transformation and govern the remarkable changes in internal crystalline structure of materials. Shape Memory Effect (SME) is performed thermally in a temperature interval depending on the forward (austenite®martensite) and reverse (martensite®austenite) transformation, on cooling and heating, whereas super-elasticity is performed by stressing the material in the strain limit in parent phase region and shape recovery is performed simultaneously upon releasing the applied stress. Shape memory effect is result of successive thermal and stress induced martensitic transformations, whereas super-elasticity is result of stress-induced martensitic transformation and performed in non-linear way, unlike normal elastic materials and exhibits rubber like behavior. Loading and unloading paths are different in pseudo-elasticity and cycling loop reveals energy dissipation. Thermal induced martensitic transformations occur on cooling with cooperative movement of atoms by means of lattice invariant shears on a {110}-type plane of austenite matrix which is basal plane of martensite. The lattice invariant shears occurs, in two opposite directions, <110>-type directions on the {110}-type basal plane. This kind of shear can be called as {110}<110>- type mode and possible 24 martensite variants occur. By this way the twinned martensite occurs on cooling and the twinned structures turn into the de-twinned martensite by means of stress induced martensitic transformation by deforming the material in the low temperature product phase condition. In the super-elasticity, parent phase structures turn into the de-twinned structure by means of stress induced martensitic transformation by stressing material in parent phase region. Copper based alloys exhibit this property in metastable beta-phase region. Lattice invariant shear is not uniform in copper based alloys and cause the formation of unusual complex layered structures, like 6R, 9R and 18R depending on the stacking sequences on the close-packed planes of the ordered lattice. In the present contribution, X-ray diffraction and Transmission Electron Microscopy (TEM) studies were carried out on two copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns reveal that both alloys exhibit super lattice reflections inherited from parent phase due to the displacive character of martensitic transformation. X-ray diffractograms taken in a long time interval show that diffraction angles and intensities of diffraction peaks change with ageing duration at room temperature. In particular, some of the successive peak pairs providing a special relation between Miller indices come close each other. This result refers to the rearrangement of atoms in diffusive manner.

### Biography

Osman Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He studied at Surrey University, Guildford, UK, as a post doctoral research scientist in 1986-1987, and his studies focused on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University in 1980

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